



The Dover Broadside

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SHOCK AT THE FRONT

Dr. William Townsend Porter, founder of Harvard Apparatus Company, was professor of physiology at Harvard Medical School. During World War I, Dr. Porter went to France at the request of the Rockefeller Institute of Medical Research to study traumatic shock. The fascinating story of his research in the trenches is contained in his book *Shock at the Front*, published in 1918 by the Atlantic Monthly Press. The story is best told by Dr. Porter himself. It is with the kind permission of the publishers and Dr. Porter's daughter, Mrs. Hildegard Heffinger, that we reprint, in serial form, *Shock at the Front*.

CHAPTER I

In an upper room of a marble palace inscribed to the memory of Junius Spencer Morgan, 'a merchant of Boston,' a dog lay dying of pneumonia. Without, the first glow of a July dawn faintly touched the great court of the Medical School. Within, the lights still burned, marking the shadows beneath the eyes of three men, sleepless for forty hours. They had kept their watch by day and night, from the moment at which the terrible Friedländer bacillus had entered the bronchial tubes, until this present hour, the hour of death. They had seen the fever rise point by point, until the impersonal column touched 106°. They had seen these fires maintained and then, the toxins finally triumphant, the sudden wonderful fall to below normal, — the fatal *descensus Averni*, — and now the coma, image and precursor of eternal sleep.

Tired were these men, but happy. A smile was on their lips, in their eyes a reverent joy. For they saw before them a new Truth, shining, resplendent, born with the day, unknown since the beginning of time.

In this dog, whose sacrifice had been so fruitful, the vagus nerves, the great strands that connect the lungs with the brain, had been painlessly severed before the disease began. There had never been a pneumonia like his. The furious respiration, — sixty, seventy, even eighty to the minute, — painful and exhausting, was absent. In spite of the mortal inflammation of the lungs, the breathing of this poor vagrant had been from beginning to end as calm, as peaceful, as that of a dog lying on a rug before the fire. It was, then, through the vagus nerves, the normal controllers of breathing, that the respiratory storm of pneumonia was let loose. This was a truth which threw a new light on the mechanism of the disease, enlarged our knowledge of normal respiration, and gave a lead for methods of relief hitherto unimagined.

How far that seemed from the trenches! But trust in the improbable underlies all creative effort. Hope, in this life the capital of the poor and the medicine of the sad, rests on the unexpected. And most unexpected was the coming of a letter from the Rockefeller Institute for Medical Research, asking if I would consent to go to France to search for the cause of 'shock' and for a remedy. In half



William Townsend Porter, circa 1917

an hour I wired consent. After thirty months of thinking, controlled by rigid experimentation, on the one subject of pneumonia, the spring fret was strong in my blood, and the great game of war had a deep appeal.

The disorder against which I was to take the field was not the mental derangement known as 'shell shock,' which comes typically without a wound, and is the result of an overwhelming jarring of the nervous system. My research would have to do with 'traumatic' shock, a condition seen only after certain injuries, the accidents of peace as well as of war.

Shell shock is marked by strange paralyses, by protean negations of our ordinary powers. Some patients cannot speak. Others tremble at a touch or a sound, however gentle, as the leaves of the quivering aspen tremble in the soothing airs of spring. Fabulous contractures appear — strong youths are bent into distorted figures like a rheumatic Nibelung. The human nerves cannot always withstand the vernal touch of war. The slow instruction of uncounted ages is forgotten; the measured harmony of functions is destroyed; the bonds of the physical body politic are broken — confusion reigns, and groups of muscles, mere hewers of wood, freed from the long control of the intelligent brain, show forth unbridled strength in powerful but uncouth forms.

Compared with this swash-buckling malady, traumatic shock is a sober, serious disease. In traumatic shock, the patient is utterly relaxed, pale as the dead, with eyes like those of a dead fish; he is apparently, but not really, unconscious; his breathing is shallow and frequent, his heart-beat rapid and feeble, and his pulse scarcely to be felt at the wrist. Much of the blood has collected in the great veins,

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VISIT TO A LABORATORY No. 4

AN EVENING WITH (ANTI) BATMAN

It looked more like a radio station than a physiologist's laboratory, but Dr. Kenneth Roeder assured us we were in the right place. Oscilloscopes, oscillators, tape recorders, condenser microphones and other electronic apparatus were banked along the walls and crammed into every conceivable nook.

"Six of my graduate students built this lab for me," Dr. Roeder said proudly of this electronic paradise affixed to his garage at his Concord, Massachusetts home. After thirty-four years with Tufts University where he is professor of physiology, Dr. Roeder now spends much of his time in his laboratory studying the sensory patterns which connect the ear and central nervous system of certain nocturnal moths. These moths, which have only two sense cells in each ear, depend on their ears for survival, for it is through their ears that they detect bats, their principle predator.

Bats, we learned, use ultrasonic chirps (inaudible to man) to aid in their flight and to find their prey. Some moths can hear these cries and try to evade the bats by spinning, diving or flying away from the sounds. The moths that can hear bats survive more than half the encounters, while moths without this sense are almost always eaten. "Imagine the aerial dog fights of World War I days," says Dr. Roeder, "and you can picture the bat-moth duels."

The simple structure of the moth's ear makes it relatively easy to trace sound signals to the central nervous system. In Dr. Roeder's experiments, a moth is immobilized on a microscope stage, the muscle cut away to expose the two tympanic nerves, and fine silver hooks are placed under one or both nerves. The hooks, or electrodes, are connected to an oscilloscope where nerve impulses are displayed as "spikes" on the screen. With the moth thus prepared, Dr. Roeder need only wait for a passing bat to provide the stimuli. His backyard laboratory annex relies heavily upon the barnfull of bats owned by "a most convenient neighbor."

Precise measurements of the nerve impulses, however, require controllable stimuli, something more dependable than the bats next door. Within his electronic laboratory, Dr. Roeder uses a high frequency generator to provide ultrasonic pulses to approximate the frequency and duration of natural bat cries (35–70 kilocycles per second, lasting 1–10 milliseconds and repeated 10–100 times a second). By observing the oscilloscope traces of moth response to the artificial ultrasound, Dr. Roeder defined the amount of acoustic information available to the moth.

continued on page 2

THERE ARE NO FROGMEN IN ATLANTIC CITY

What's it like to be in the wilds of Convention Hall without a frog?

We found out a year ago at a Federation Meeting in Atlantic City. We had just set up our elaborate physiologic equipment and had stepped back to admire its esthetic qualities when the Chief Engineer nodded his approval and said "O.K., bring out the frogs." "Frogs?" queried the Production Manager, "ask the Sales Manager about them." "Thundering tadpoles," said the Sales Manager, "I guess they're back at the barn."

Rather than disappoint those who had come specifically to see our frog consuming apparatus, we quickly explored all possible ways to procure some frogs.

The Chief Engineer was deployed to the convention management. They offered fixtures, frankfurters, folders, frames, fall-out shelters and fine flowers, but no frogs. The Production Manager walked through the Yellow Pages, and discovered Fraternal Organizations, Freight Forwarding and Frozen Foods (Wholesale & Retail) but no frogs. The Sales Manager (who is paid to be bright) asked a cab driver, who had abundant knowledge of Fred-dies and Frugs but not of frogs. It was the Vice President, of course, who thought of a fish market, and off we went to Becker's Fish Market at 909 Atlantic Avenue. "Yes, we have



no frogs," said a friendly face between the codfish and the carp. "Fresh fish, smoked fish, shell fish, blue fish, but no frogs. Frogs legs don't get much play in Atlantic City. People come here all the way from Iowa to eat steak." We explained our urgent need and he began to laugh halfway through the tale. Then he introduced himself as Myron Becker, Ph.D., who runs the family fish market and moonlights in physiology. Dr. Becker easily rattled off the rest of the apparatus common to frog muscle experiments and readily sympathized with our problem. "Don't suppose you could use a turtle?" said he. Oh, yes we could. "Don't have one of those either," replied Dr. Becker, but you might try this farmer over on the mainland who might have a turtle in his creek.

We did.

He didn't.

There were no live demonstrations in the exhibit booth that year, but we made a friend of Dr. Becker who has promised to be our official procurer of fine frogs in Atlantic City.

CASE HISTORY No. 4

RAT DECAPITATOR

The classic method of rodent dispatch had failed again. "Rats!" groaned the distraught lab technician, "if my career depends upon executing these little beasts, you can have it!"

To Dr. Guido Majno of the Harvard Medical School, such distressing scenes were becoming commonplace. Much of the pathology department's research depended on rats . . . dead ones, that could yield a vital organ for specific study. Once dead, the rat cooperated nicely but there was always that indelicate procedure of preparing the indispensable rodent for his demise.

The classic method had evolved early in the use of rodents for research. Poison was out. It inevitably caused some damage to the normal condition of vital organs. Suffocation, too, was eliminated for it was often prolonged and traumatic. Researchers had agreed that the proper way to dispatch a rat was to render it senseless, then sever its head with a pair of shears. Style in delivering the knock-out blow to a rat was largely left to personal preference. But whenever this classic method was less than successful, disgruntled lab technicians would huddle to discuss mutiny.

Such was the case on that bleak day in the Pathology Lab. Dr. Majno turned to Harvard Apparatus for help. Design an instrument for severing a rat's head without first knocking it out, he urged. We replied that it was a little out of our line, but try we would!

Unschool in the art of animal beheading, we called upon a neighboring inventor-model builder in Dover, William Van Brocklin, who doubles as father to our Chief Engineer, Bill Junior. Mr. VB willingly set about the design and soon delivered the initial prototype. It was simply a knife blade and a small box with a hole, through which the rat would poke his head while the decapitating stroke was made. A great advance, it seemed! Rodent was spared the preparatory blow, technician was spared a possible failure, and there was even a neat receptacle to catch the disembodied head.

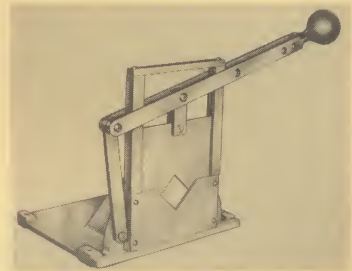
But we failed to reckon with the rat! Under test, the rat refused to put his head in the dark, foreboding hole. And who could blame him? Coax as we might, the wary rodent backpeddled nervously whenever confronted by the unknown darkness.

Our next design, a fear-free dispatcher, turned out to be a more dramatic masterpiece of engineering but no more suitable for the purpose. The theory of operation involved an electronically triggered automatic knife blade actuated by the rat himself as he passed through a special tunnel. However, the rat could not be counted on to remain in the precise spot long enough to get the job done. The fool machine was just as likely to slice off the tip of his tail.

By this time, the elder Van Brocklin had become an ardent student of rodent psychology. "Pesky little things can't be trusted," said he. So he removed all possibility of unpredictable behaviourism in rats by designing a simple set of shears. The new device looked uncomfortably like a guillotine and required the return to prominence of the lab technician as its indispensable accessory.

Tucking the gleaming instrument under his arm, inventor Van Brocklin marched into the Harvard pathology building, convinced that the problem was now solved. Apparently the pathologists could readily tell that a scientific breakthrough was at hand for he was stopped several times by curious M.D.'s who asked "That thing for rats?" He arrived at Dr. Majno's door with three firm orders for the first production run.

Success at last! The new design proved to be sheer genius. Father turned over the project to Son and the specifications were prepared. As befits Harvard Apparatus Company's reputation, we decided that if we were going to build rat decapitators, we were going to build them right! We prescribed the use of a cast



aluminum base, stainless steel hardware, anodized aluminum fittings and, antedating the big razor blade companies, stainless steel blades.

Alas! While stainless steel is an admirable material, it is too soft to hold a proper cutting edge. A special type had to be found which could be hardened to retain a razor edge. The process of manufacturing good stainless steel blades turned out to be a tedious one. First, the blades are machined, then hardened to Rockwell 50. The hardening process warps the steel so it must be ground flat again which requires, of course, that the blades be made thicker in the first place. The grinding process quite naturally leaves grinding marks, so the blades must finally be hand-honed and polished. The result, however, is a superb decapitator blade.

The fame of our new product spread far and wide. Orders for "guillotines," "beheaders" and even "rat-choppers" came in from all over the world. We soon found that our customers agreed that decapitation is the most humane method of dispatching a rat known to man. In response to popular demand, we now have available a large animal decapitator, which we rarely mention.

Seldom advertised, the decapitator is always displayed in the Harvard Apparatus exhibit at medical conferences. It never fails to draw an endorsement from a proud owner. We like the story told by a visiting researcher during the recent Federation meeting at Atlantic City. It seems his technicians had developed a special accessory for the decapitator by cutting both ends out of a beer can, through which the rat is allowed to run. When the animal pauses to poke his head out of the far end of the can he is in perfect position for the *coup de grace*. Said the doctor, "We call it our Budweiser Mousen Housen."

For further information, write for Bulletin 142 or use the return request card enclosed with this issue of the Broadside.

HOW DO YOU SAY IT IN ENGLISH?

One of our faithful readers at the Scripps Institution of Oceanography, La Jolla, California, responded to the challenge of page four of the previous Broadside ("How Would You Say It in Esperanto?"). We are grateful to Mr. Lewin for supplying the following exchange in Esperanto:



Dear Harvard Apparatus:

Here is my answer to your question, asked on p. 4 of THE DOVER BROADSIDE, Fall 1965.

Li: Mi petas, bonvole sendu unu peristaltan pumpilon, aŭ du, al mia laboratorio en Anglio.

Ni: Volonte.

Li: Mia kolegoj en Dartmouth diras ke viaj aparatoj estas bonege konstruataj . . . sed, mi demandas, ĉu vi povas diri al mi . . .

Ni: Jes, Sinjoro?

Li: Kio ajn estas brika necesejo?

(Now, I wonder if any of your readers would be unable to translate this back into English.)

RALPH A. LEWIN

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CHANGE IS OUR MOST IMPORTANT PRODUCT

We're pleased when someone else helps to fill the pages of our occasional Broadside. Such an opportunity has come this way from a place called Kansas. That this gentleman's experience with our products is not typical, we shall let you judge for yourself.

Dear Harvard Apparatus:

Your letter of July 1, which told me that the 1403 blood pump was being further changed, and thus improved, warmed my spirit. Your catchy little slogan, "change is our most important product," caught my fancy, and I set it to music. I found myself humming bits of it as I worked with our old, unchanged Sigmamotor pump. As I hummed, my entire outlook on life improved. My digestive juices never worked better. In brief, I was happy.

Two days ago, the 1403 arrived. We tenderly uncrated it, and opened the envelope marked "Important, operating and maintenance instructions." Inside was preliminary bulletin on the 1400 Series Pulse Duplicator. In a moment, I understood. The operating and maintenance instructions had *changed* into the Preliminary Bulletin, perhaps during shipment. Decidedly clever.

My technician then began probing for the 1403's soul (he was sure that it had one). He removed a small plate and peered inside. He saw immediately that the soul was not there, and he replaced the plate. As he tightened the last screw, he jumped back and screamed that the 1403 had *changed* into a small animal respirator. I coolly investigated and learned that the plate carried two labels, one inside and one outside. The technician had simply replaced the plate with the inside out. I won-

SHOCK AT THE FRONT (cont.)

the heart is poorly filled, the driving pressure of the blood in the arteries is less than half the normal — too low for the maintenance of a proper circulation of blood to the brain; the brain-cells suffer for lack of food.

Men rarely die of shell shock. The methods of cure are sometimes as interesting as the disease itself. In the summer of 1916, there was a spirited discussion among the French as to the right of a soldier to refuse treatment for shell shock. The treatment in question was directed against the deformities resulting from the continued contraction of certain groups of muscles. A soldier, bent like a rag-picker searching in the dust of Montmartre, was grasped under each arm by a stout assistant surgeon. To the muscles opposing the contracted group, the chief surgeon then applied a strong electric current in such a way that the resultant contraction would inevitably cause the patient to straighten up. The instant this occurred, the assistants walked off with the astonished patient, now in the erect position. The malign spell was broken. The patient saw that he could stand erect, and the battle was won.

The electric current used was irritating and certainly surprising, but it was not dangerous, or even very painful. Cures were many, and the method got into the newspapers. There it was called 'torpedoing.' Phrases may be more harmful than artillery fire. They should

der if I have discovered a wonderful secret. Can this mean, and I dare not ask this above a whisper, that the 1403 is simply a small animal respirator turned inside out? Can we, should the need arise, grasp a certain region of the 1403's innards, and, by skillful pulling, change the 1403 into a small animal respirator? And vice-versa?

The backside of the Preliminary Bulletin (of which I now have 3 copies) tells us that "all components in contact with fluid are easily disassembled for cleaning." Finding two wrenches in the packing case, we proceeded to test this hypothesis. After examining the pump chamber and valve head carefully, we turned the locking ring to remove the valve head. After several turns it was apparent that we were tightening, not loosening, the head. Embarrassed, we then turned the ring in the reverse direction and were amazed to discover that we again were tightening the head. After repeating this experiment several times, we gradually realized the obvious, the threads constantly were *changing* from right hand to left hand threads and then back again.

In brief, I agree with you. Change is your most important product. I occasionally surreptitiously look into the "Important, operating and maintenance instructions" envelope to see whether the 1400 Preliminary Bulletin has changed itself back to the instructions, but so far, I am sad to report, it has not.

Help!

K. L. GOETZ, PH.D.

Department of Physiology

University of Kansas Medical Center

Kansas City, Kansas

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rightly be detained until their virus is measured. This phrase worked mischief.

One day there came a soldier who refused to be torpedoed. The chief surgeon insisted. The patient struck out wildly. From words they came, alas, to blows! The surgeon was an educated man; he had defended a Thesis; he knew *la boxe*; he was versed in what Littré terms the *pugilat anglais*. And, since knowledge is power, he prevailed — without electricity. The result was a resounding scandal and the complete cure of the patient. The affair came at length before the Academy. It was decided that a soldier should suffer the surgeon, as a patriotic duty.

Men rarely die of shell shock, but traumatic shock is usually fatal when skilled assistance is not at hand. Not less than twenty thousand men are dying each year of traumatic shock in the English and French armies.

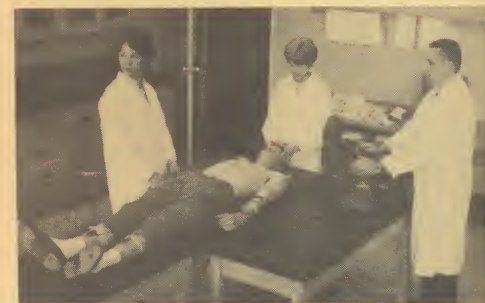
Surgeons had long recognized this calamitous condition as a formidable adversary. The cause of the disease was unknown. There had been many hypotheses; the two most important survived for more than a generation. One of these hypotheses declared that shock was due to the exhaustion of the brain-cells which regulate the blood-flow by controlling the bore of the small arteries; the other discovered the cause of shock in the irritation of the sensory nerves. Both these hypotheses I had overthrown by experiments in the laboratories of the Harvard Medical School. It was these investigations which procured for me the opportunity to study shock at the front in this war.

The remedies for shock left much to be desired. It was the hope of those who sent me, that some new remedy might be found.

My adventures in the search for the cause of shock and for a remedy are set forth in these pages.

Shock at the Front will be continued in the next issue of the Broadside.

PUBLICATION ANNOUNCEMENT



We are pleased to announce the publication of *Experimental Physiology and Applied Biology* by Tassos P. Filledes. Broadside readers will recall the article in our last issue which described the development of this laboratory manual for advanced classes in Physiology at the High School and College level. The first printing is due in January, 1967, by Educators Publishing Service, Cambridge, Mass. 02139, at a price to teachers of \$2.50. Harvard Apparatus will include the book in its teaching kits and offer it as a regular catalog item. See our inquiry card for further details.



HARVARD APPARATUS CO., INC. • Dover, Mass., 02030

Tel: 617-785-0700